

NASA TECH BRIEF

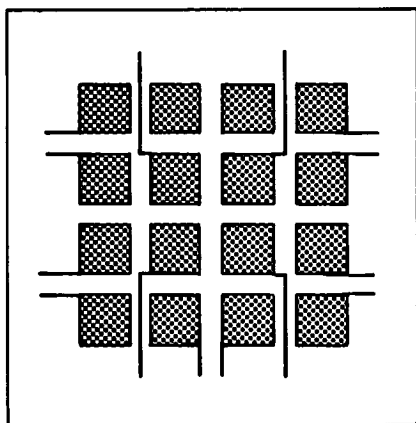
Ames Research Center



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Piezoelectric Transducer Mosaic

The need for a mosaic or assembly of piezoelectric transducers arose during an experimental program for evaluating the application of an acousto-optical imaging system as a nondestructive test. In this system, acoustic waves (4–100 MHz) are transmitted



through a liquid coupling-medium surrounding the solid to be tested nondestructively; an inhomogeneity in the structure of the solid distorts the sound waves as they travel through the coupling medium toward a mosaic of piezoelectric sensors. Each element of the mosaic (an individual piezoelectric crystal) converts the mechanical energy of the sound wavefront to equivalent electrical energy. The portions of the wavefront that are not distorted by a flaw (crack, void, density variation, etc.) in the test item induces a certain kind of response in the sensor mosaic, and

the part of the wavefront that is distorted by the flaw induces a different and readily detectable response. By appropriate arrangement of sensors, not only is the flaw detected, but its relative position in the item being tested is also located in terms of X and Y coordinates. In order for the sensor arrangement to work properly, the fundamental frequency of each crystal in the mosaic must be very closely matched; because the process of selecting precisely matched crystals is especially tedious and costly, it was necessary to seek better methods for manufacturing piezoelectric assemblies.

Borrowing from integrated circuit technology, it was found that the mosaic can be formed from a substrate consisting of a single X-cut quartz crystal or any other piezoelectric crystal. One side of the precisely lapped crystal substrate is plated in the normal fashion. The mosaic pattern on the other side is produced by depositing the plating material through a stainless steel mask that has been chemically etched with the desired pattern. As shown in the figure, the transferred pattern produces a mosaic of 16 individual crystals. Since the fundamental frequency of the quartz crystal substrate is a function of its thickness, it is much easier to manufacture a single crystal for a given frequency response than 16 separate crystal transducers. Furthermore, all of the crystals formed on a substrate have precisely the same thickness and, therefore, the same fundamental frequency. Additionally, use of a large substrate avoids the need of a complex mounting for the mosaic.

(continued overleaf)

Notes:

1. The substrate is 2.54 cm square and each crystal is 0.318 cm by 0.318 cm.
2. Requests for further information may be directed to:

Technology Utilization Officer
Ames Research Center
Moffett Field, California 94035
Reference: B72-10014

Patent status:

No patent action is contemplated by NASA.

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